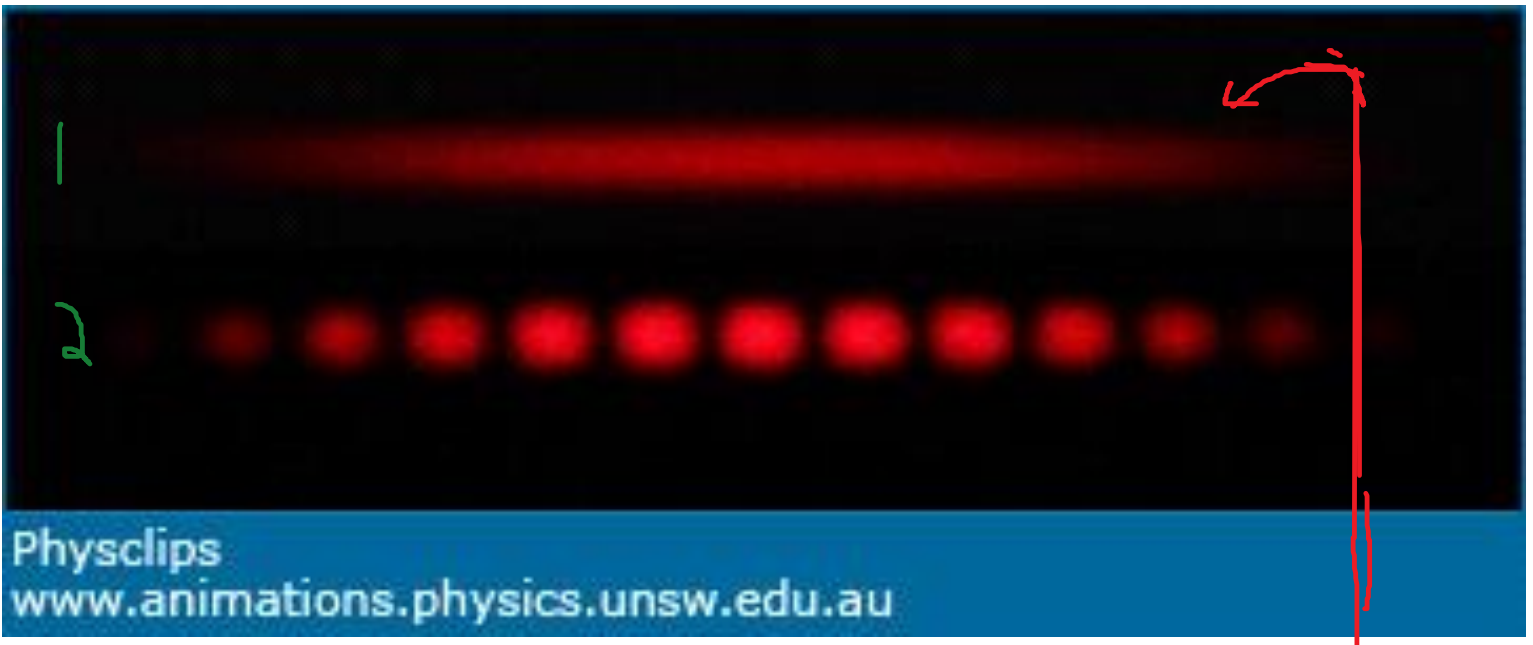
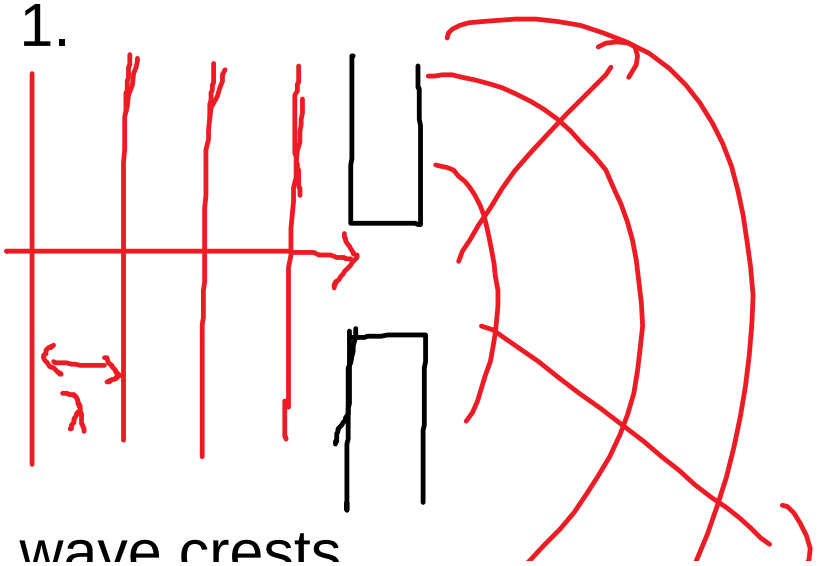
Chapter 19, Diffraction and Interference

When a helium/neon laser is shone through
1. A very narrow slit
2. two very narrow slits
   the following patterns are seen on the screen
   at the back of the class:

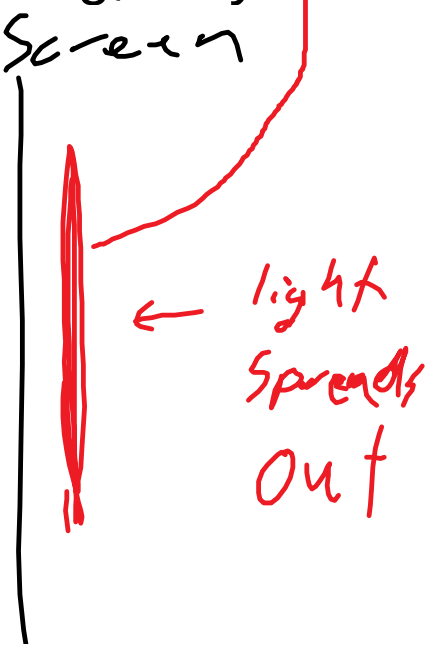


What's going on?
When waves go through a small opening, they spread around it - diffraction

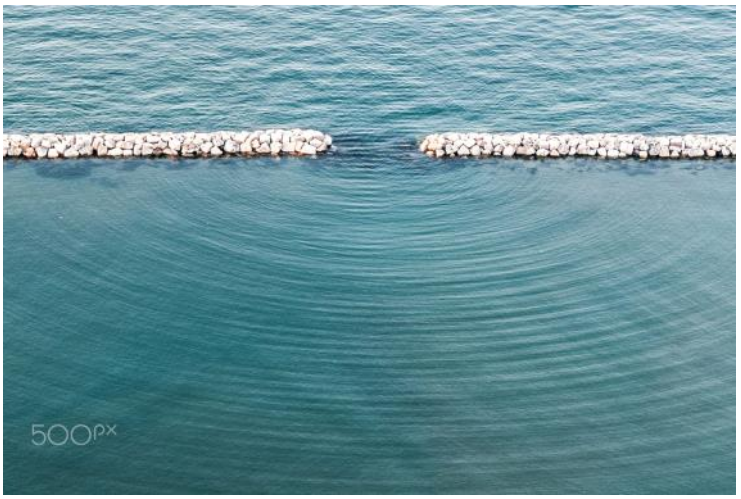
1.



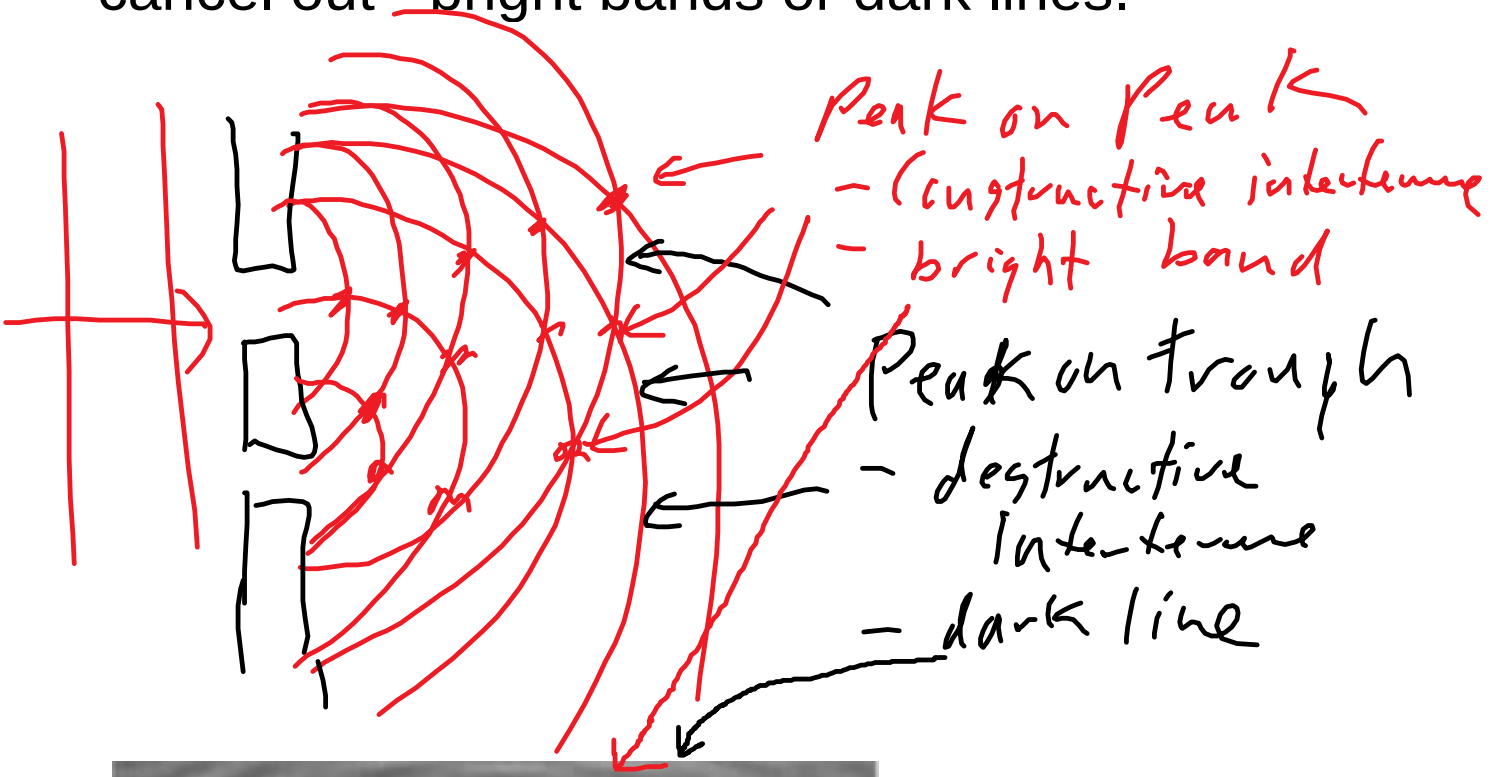
wave crests

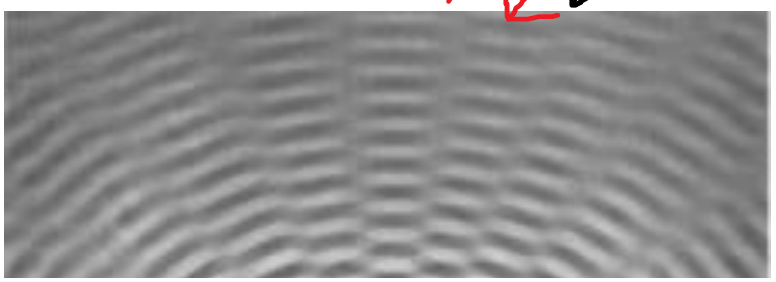


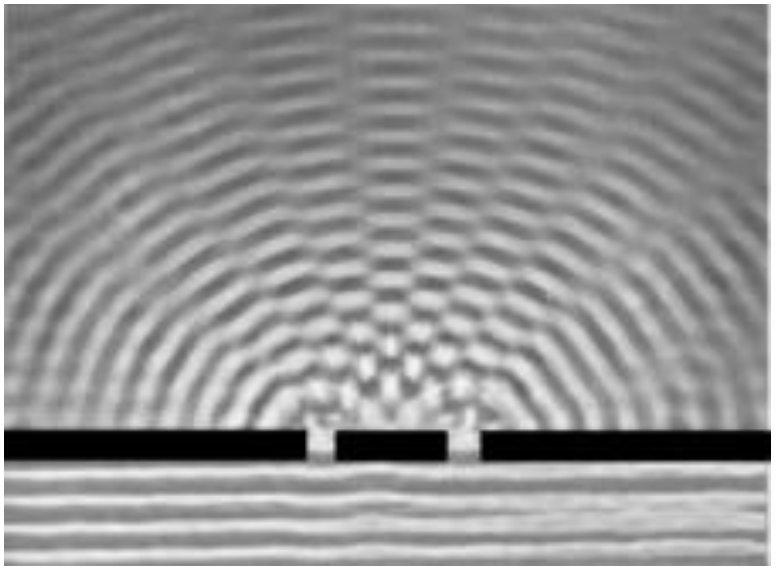
wave crests
from top view



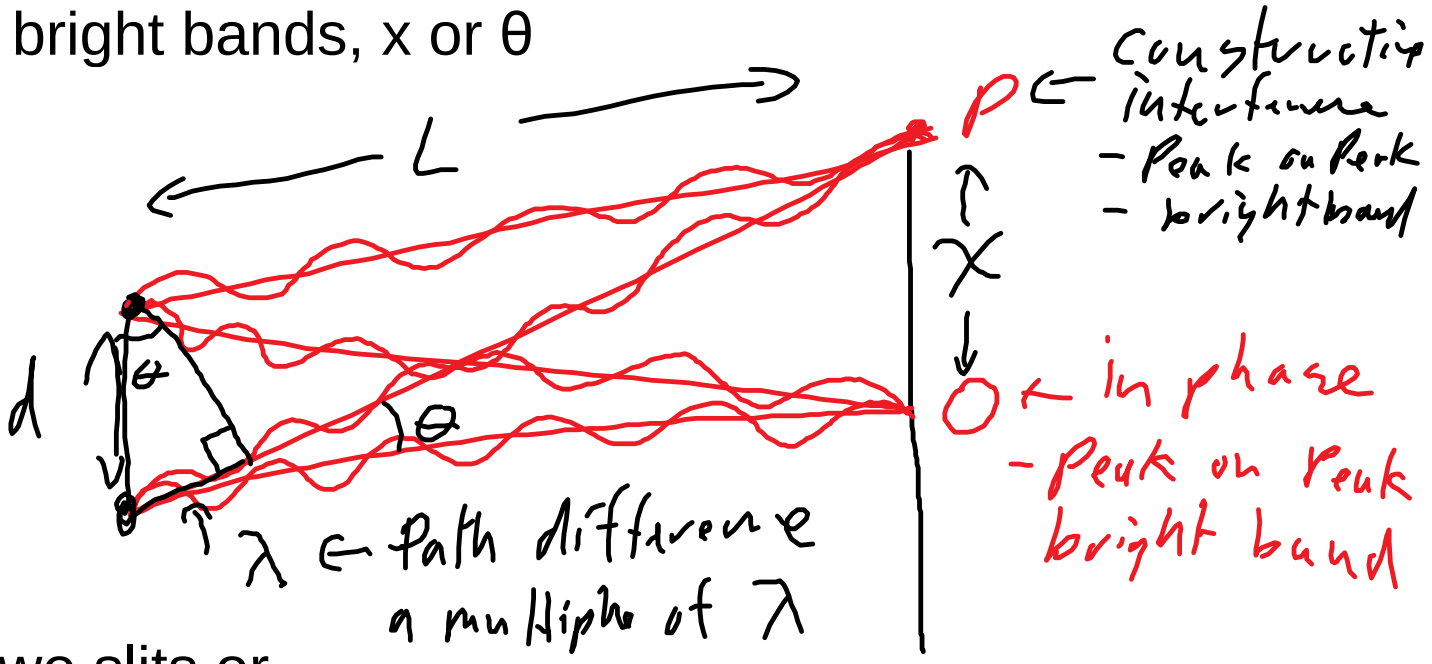
2. when the waves go through two slits, the sets of waves will overlap and interfere - add together or cancel out - bright bands or dark lines.







Let's derive an equation -
variables?
wavelength
distance between the slits, d
distance or angle between the centre of the bright bands, x or θ



two slits or
two sources
same wavelength
and in phase

screen

$$\sin\theta = \frac{n\lambda}{d}$$

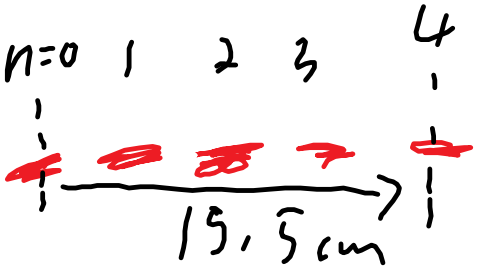
and in phase

$$\sin\theta = \frac{n\lambda}{d}$$

n is a whole number - the number of the bright band- start counting at zero.
θ is the angle between the centre of the zeroith bright band and the nth band
λ is the wavelength
d is the distance between the slits/sources.

since θ is difficult to measure, we approximate $\sin\theta = \tan\theta = x/L$ (small angle approximation)

eg. I shine a laser with wavelength 632.8 nm through two slits and observe the following pattern on the screen 6.42m away:



What is the distance between the slits?

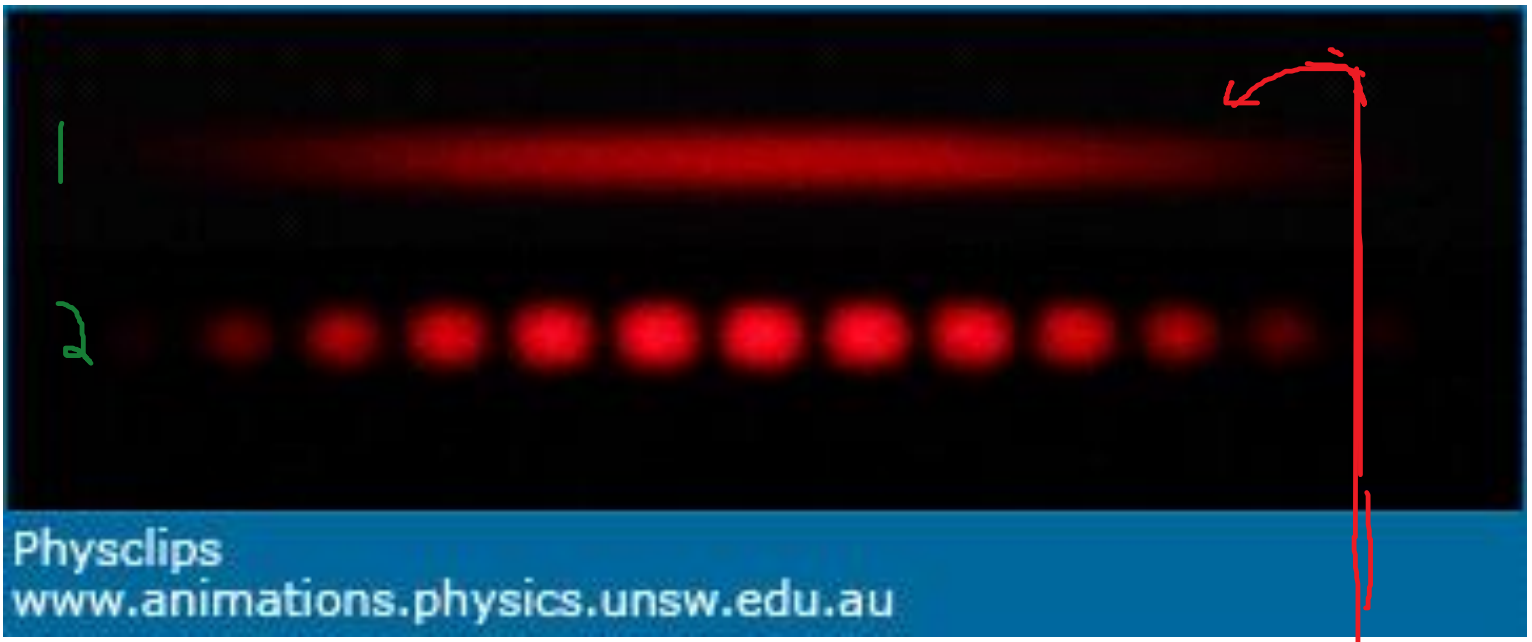
$\lambda = 632.8\text{ nm} = 6.328 \times 10^{-7}\text{m}$
L=6.42m
x=15.5cm = 0.155m

n=4
d=?

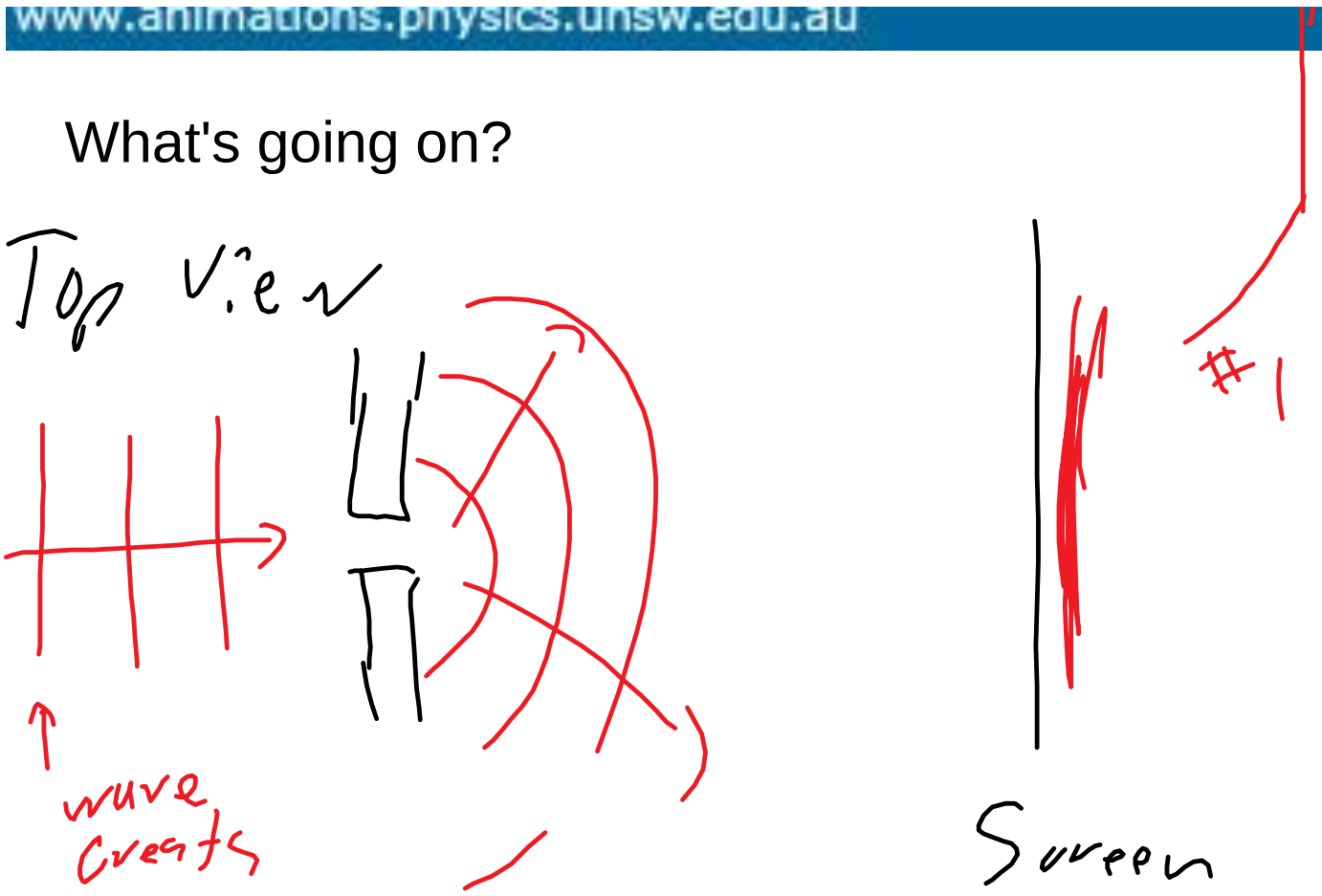
$n\lambda/d=x/L$
$d=n\lambda L/x = 4x6.328x6.42/0.155=1,048.4067$
$x10^{-7}m$
$d= 1.0 \times 10^{-4}m = 0.10\ mm$
Homework
Q1-4 Ch 19

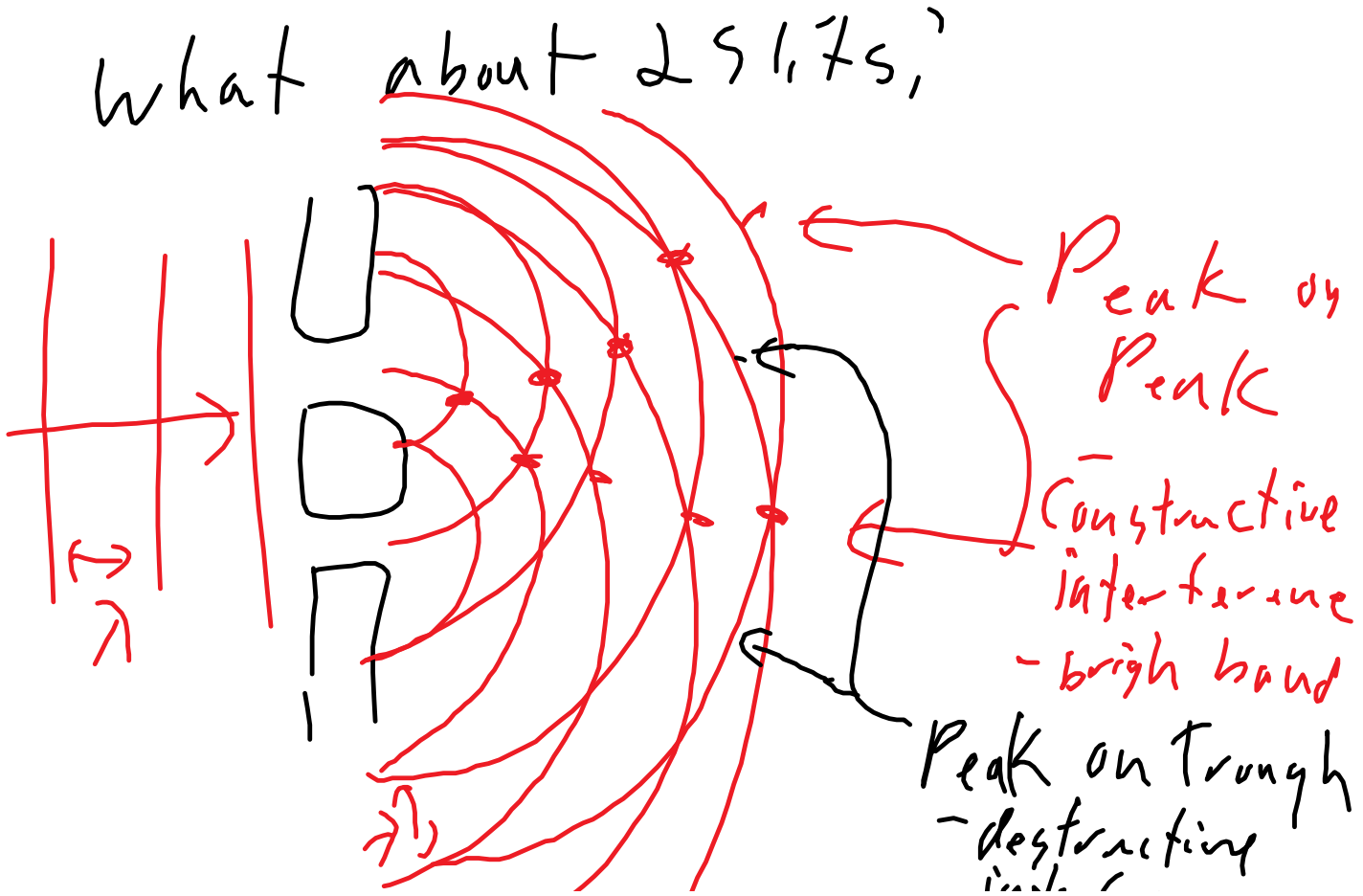
Chapter 19, Diffraction and Interference

When a helium/neon laser is shone through
1. A very narrow slit
2. two very narrow slits
   the following patterns are seen on the screen at the back of the class:



What's going on?



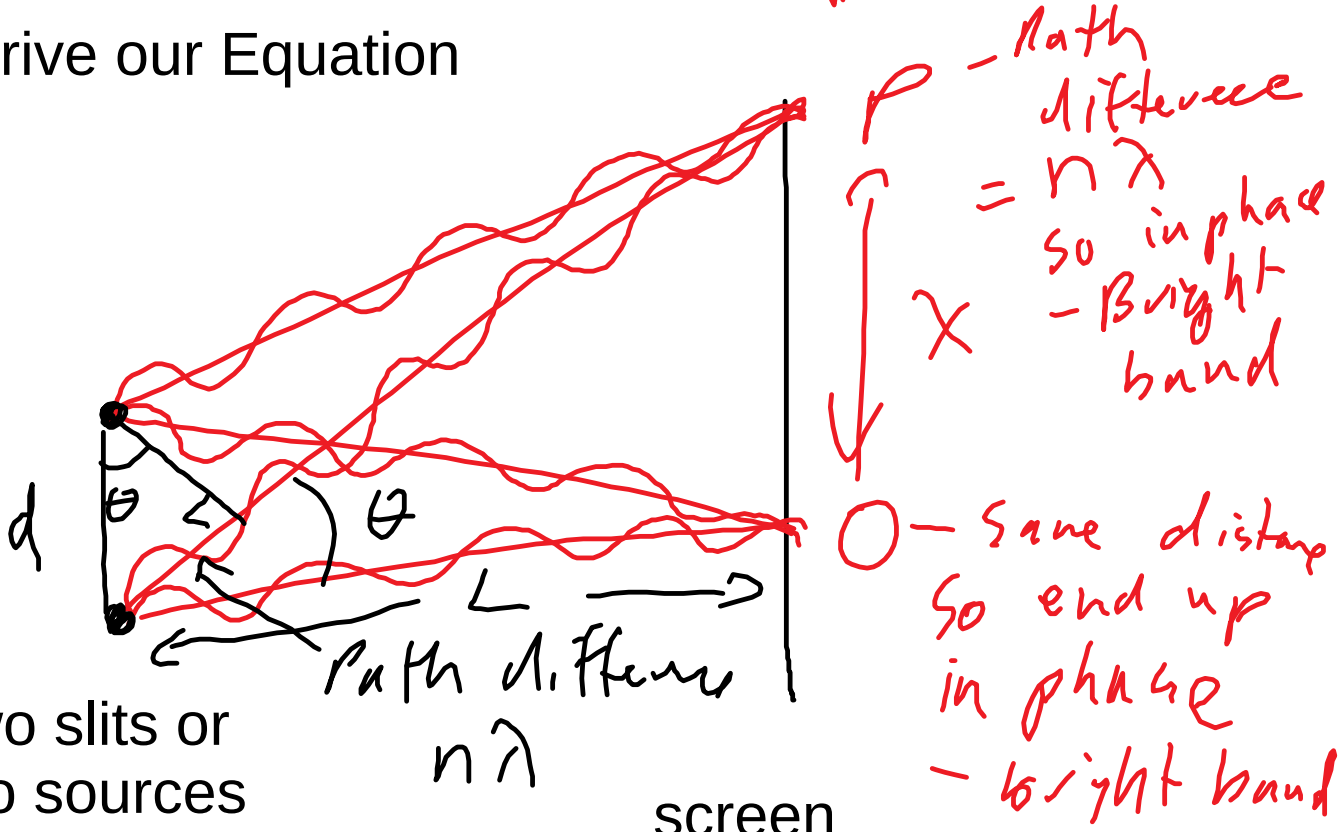


- destructive interference
- dark line

Screen

bright
dark
bright
dark
:

Derive our Equation



Two slits or
two sources
same wavelength
and in phase
(peaks on peaks)

$\sin\theta = n\lambda/d$

θ is the angle bewteen the centre of the zeroith bright band and the nth band.

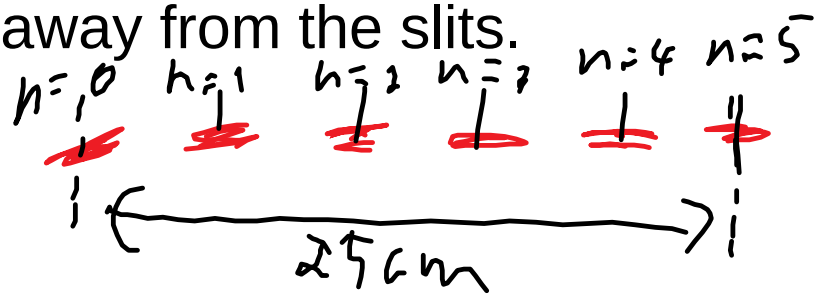
n is a whole number, the number of bright bands

λ is the wavelength
d is the distance between the slits/sources.

The angle is a pain to measure, so sometimes we use the small angle approximation:

$\sin\theta \cong \tan\theta = x/L$
$\sin\theta = n\lambda/d = x/L$

eg. I shine a helium/neon laser, wavelength 632.8nm, through two slits and observe the following on the screen at the back of the class, 6.52m away from the slits.



What is the distance between the slits, d?
$\lambda = 632.8nm = 6.38 \times 10^{-7}m$
L=6.52m
n=5
x=25cm=0.25m
$n\lambda/d = x/L$

$n\lambda L = xd$
$d = n\lambda L/x = 5 \times 6.38 \times 6.52/0.25 = 831.952$
$8.3 \times 10^{-5}m$ = 0.083mm wow close together.

Homework

Q1-4 chapter 19